

REMARKS

Claims 1-26 remain pending in the above-identified application and stand ready for further action on the merits.

Claim Rejections under 35 USC § 102/103

Claims 1-11 and 14-26 have been rejected under 35 USC § 102(b) as being anticipated by or under 35 USC § 103(a) as obvious over Braat et al. (US 6,211,327). Claims 16-26 have been rejected under 35 USC § 102(b) as being anticipated by Dalton et al. (US 4,463,164). Further, claims 1-15 have been rejected under 35 USC § 102(b) as being anticipated by or under 35 USC § 103(a) as obvious over Dalton US'164. Still further, claims 1-11 and 14-15 have been rejected under 35 USC § 102(b) as being anticipated by or under 35 USC § 103(a) as obvious over WO 00/46273.

Reconsideration and withdraw of each of these rejections is respectfully requested based upon the following considerations.

The Present Invention and Its Advantages

The present invention relates to a polyphenylene ether (PPE) having a relatively low molecular weight and a narrow (sharp) molecular weight distribution. More specifically, the polyphenylene ether has a specific reduced viscosity (a reduced viscosity (η_{sp}/c), as measured at 30°C in a 0.5g/dl chloroform solution, of 0.04-0.18 dl/g) and a specific molecular weight distribution (a molecular weight distribution of 1.5-2.5).

The low molecular weight PPE of the present invention has high thermal resistance, excellent electric properties and solubility to various solvents or reagents, and has good ability of mixing or reacting with other components.

The present invention also pertains to a process for producing the low molecular weight PPE efficiently by selectively precipitating the low molecular weight PPE.

Distinctions of Product Claims (claims 1-11 and 14-15) over Braat US'327

Braat US'327 fails to teach or disclose "a molecular weight distribution of 1.5-2.5".

The low molecular weight PPE of the present invention is distinguished from PPE obtained in the cited reference. For example, in Comparative Example 5 as described at page 27 of the instant specification, PPE was obtained according to the method of Braat US'327 (see page 27, lines 9-10 of the instant specification). PPE obtained according to Braat US'327 has a molecular weight distribution of 2.68 (see Table 1 at page 30 of the instant specification), while the molecular weight distribution of the present invention is 1.5-2.5. That is, the molecular weight distribution of the present invention is narrower (sharper) than that of Braat US'327.

In the outstanding Office Action at page 3, lines 12-17, the Examiner states as follows:

"...the composition disclosed by the reference is prepared from reactants and under process conditions that are inclusive of the claimed reactants and conditions. In view of this similarity, it would appear to be inherent that the product, low MW PPE having the claimed MW distribution, ...could be prepared following the teaching of the reference."
(emphasis added)

However, it is also noted that methods disclosed in the present application that can be used to obtain the product of the present invention are also distinguishable from Braat US'327.

The low molecular polyphenylene ether of the present invention can be obtained by, for example, the method of claims 16-26 (the method of the present invention). In the method of the present invention, “adding a poor solvent of said low molecular weight polyphenylene ether to the polyphenylene ether solution obtained by said polymerization to precipitate said low molecular weight polyphenylene ether” is one of the features (see claim 16). Namely, adding the poor solvent to precipitate the low molecular weight PPE is one of the features of the method of the present invention used to prepare low molecular weight PPE of the invention.

In contrast, Braat US'327 fails to teach or disclose such a method. For example, in the cited reference, as described at column 2, lines 20-35, PPE is isolated through devolatilization of the reaction solvent. This description means that the method of the cited reference is a solution method, in which usually a precipitation of PPE never substantially takes place. Further, it is known that PPE obtained by a solution method has a broader molecular weight distribution, since the polymerization of PPE takes place continuously in a good solvent for PPE (see Comparative Example 5 as described at page 27 of the instant application).

Further, at page 3, lines 7-8, of the outstanding Office Action, the Examiner states that “the reaction media comprises an aqueous media and an anti-solvent to help drive the precipitation of the copper species (see col. 6, lines 36-52).”

However, this is quite different from the instant methods where a poor solvent is used to precipitate the low molecular weight PPE.

More particularly, Braat US'327 fails to disclose or suggest “adding a poor solvent of said low molecular weight polyphenylene ether to the polyphenylene ether solution obtained by said polymerization to precipitate said low molecular weight polyphenylene ether”.

Further, Braat US'327 fails to teach and suggest specifically any manner to control, especially narrow (sharpen), the molecular weight distribution of the low molecular weight PPE.

Accordingly, claims 1-11 and 14-15, which ultimately depend from claim 1, are never anticipated by or obvious over Braat US'327.

Distinctions of Process Claims 16-26 over Braat US'327

The process of the present invention includes features such as “adding a poor solvent of said low molecular weight polyphenylene ether to the polyphenylene ether solution obtained by said polymerization to precipitate said low molecular weight polyphenylene ether” (claim 16) and “precipitating said low molecular weight polyphenylene ether in the course of the polymerization; wherein the polymerization solvent is a mixture of at least two alcohols” (claim 20).

However, as described above, Braat US'327 fails to disclose and suggest such features.

Accordingly, claims 16 and 17-19 (which depend from claim 16) and claims 20 and 21-26 (which depend from claim 20) are submitted to not be anticipated by or obvious over Braat US'327.

Distinctions of Process Claims 16-26 over Dalton US'164

The present invention is directed at a process for producing low molecular weight PPE having a reduced viscosity (η_{sp}/c), as measured at 30°C in a 0.5g/dl chloroform solution, of 0.04-0.18 dl/g, and a molecular weight distribution of 1.5-2.5. Further, as described above, the process of the present invention has features such as “adding a poor solvent of said low

molecular weight polyphenylene ether to the polyphenylene ether solution obtained by said polymerization to precipitate said low molecular weight polyphenylene ether” (claim 16) or “precipitating said low molecular weight polyphenylene ether in the course of the polymerization; wherein the polymerization solvent is a mixture of at least two alcohols” (claim 20).

However, PPE having such properties cannot be obtained by the method disclosed in the cited reference. In the cited Dalton reference, aliphatic hydrocarbons, such as octane, are used to precipitate PPE (see column 3, lines 34-36). However, as described at page 16, line 27-page 17, line 2 of the instant specification, aliphatic hydrocarbons such as hexane, heptane, etc., are a good solvent for the low molecular weight PPE of the present invention, which has a reduced viscosity (η_{sp}/c) of 0.04-0.18 dl/g. As such, the low molecular weight PPE of the present invention is not precipitated, but is still dissolved in such good solvents. That is, the cited Dalton reference fails to disclose and suggest “adding a poor solvent of said low molecular weight polyphenylene ether to the polyphenylene ether solution obtained by said polymerization to precipitate said low molecular weight polyphenylene ether” (see claim 16) .

Accordingly, claims 16-26 are not anticipated by or obvious over Dalton US‘164.

Distinctions of Product Claims 1-15 over Dalton US‘164

Dalton US‘164 fails to disclose and suggest “a reduced viscosity (η_{sp}/c), as measured at 30°C in a 0.5g/dl chloroform solution, of 0.04-0.18 dl/g, and a molecular weight distribution of 1.5-2.5.”

At page 5, lines 7-8, the Examiner states that the specific characteristics are inherent in the cited reference because of a similarity of process conditions.

However, as described above, PPE disclosed in the cited reference does not have the specific characteristics of the instant invention.

Accordingly, claims 1-15 are not anticipated by or rendered obvious by the Dalton US'164 reference.

Distinctions of Product Claims 1-15 over WO'273

WO'273 also fails to disclose and suggest "a reduced viscosity (η_{sp}/c), as measured at 30°C in a 0.5g/dl chloroform solution, of 0.04-0.18 dl/g, and a molecular weight distribution of 1.5-2.5."

In WO'273, PPE is isolated by a devolatilization (see page 12 line 3 from the bottom and page 17, line 4 from the bottom of the reference). Namely, the method for producing PPE disclosed in WO'273 is also the solution process, wherein after polymerization, solvent is devolatilized from the polymer solution. As such, PPE described in the cited references has a broader molecular weight distribution than that of the present invention.

Therefore, as explained above regarding Braat US'327, the process of WO'273 is different from the method of the present invention and the PPE of the present invention is also distinguished from the cited reference.

Further, WO'273 fails to teach and suggest specifically any manner to control, especially narrow (sharpen) the molecular weight distribution.

Accordingly, claims 1-15 are not anticipated by or obvious over WO'273.

Unexpected Results of the Present Invention

As shown in Table 1, the low molecular weight PPE of the present invention has unexpected results in, for example, high thermal resistance, and electric properties, which are not suggested in the cited references. Further, according to the process of the present invention, such an excellent PPE can be produced productively.

CONCLUSION

Based upon the remarks presented herein, the Examiner is respectfully requested to issue a Notice of Allowance clearly indicating that each of the pending claims 1-26 are allowed under the provisions of Title 37 of the United States Code.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact John W. Bailey (Reg. No. 32,881) at the telephone number below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Application No.: 10/500,701

Docket No.: 0071-0593PUS1

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Dated: JUL 27 2005

Respectfully submitted,

By 

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